

Research Article

Effects of Organic Soil Amendments on Photosynthetic Traits of Black Pepper (*Piper nigrum* L.) in an Alluvial Soil

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Black pepper in Sarawak, Malaysia, is mainly cultivated using the conventional method involving heavy usage of chemical compound fertilizers. Organic soil amendments can reduce the required amounts of chemical fertilizers. So, the objectives of this study were to compare selected properties of soils as well as the physiological performances of mature vines following the application of fermented juices, biochar, and compost. There were five treatments; each replicated five times in a randomized complete block design. Treatments were as follows: (i) FNPK–NPK 15 : 15 : 15 compound fertilizer; (ii) FPJ (fermented plant juice); (iii) FPJBC (FPJ, biochar, and compost); (iv) FFJ (fermented fruit juice); and (v) FFJBC (FFJ, biochar, and compost). The results revealed that combined fermented juices, biochar, and compost positively improved soil bulk density, soil porosity, TOC, C/N ratio, available P, exchangeable K, and exchangeable Ca. The fermented juices incorporated with biochar and compost had favourable effects on the leaf chlorophyll concentration, Normalized Difference Vegetation Index (NDVI), and gas exchange rates such as photosynthesis, stomatal conductance, and transpiration. Pepper leaf chlorophyll, NDVI, and photosynthesis rate were negatively correlated with soil total N. These results suggested that introducing organic soil amendments such as fermented juices, biochar, and compost improved soil physiochemical properties and black pepper physiological traits.

1. Introduction

In black pepper cultivation, a healthy and vigorously grown vine is characterized by fully developed canopy which wholly covers the pole which supports it. As pepper is a nutrient demanding plant especially the mature vines, adequate nutrition to ensure plant health and flower initiation is essential [1, 2]. Managing mature pepper vines require a different form of farming practices including fertilization programmes. Paulus [3] mentioned that fertilization of mature vines is done at the onset of the rainy season to induce flowering. There is

usually no further application of granular compound fertilizer from January to June (berry filling stage right to harvesting). In Sarawak, pepper vines are mainly fertilized using chemical fertilizers. The existing formulations for mature pepper vines are 12 : 12 : 17 : 2 + TE and 14 : 14 : 21 : 2 + TE [3]. Paulus and Anyi [3] calculated that approximately 1.5 kg/vine/year or three tonnes/hectare/year of 12 : 12 : 17 : 2 + TE fertilizer is needed to fertilize mature vines in four splits, that is, 40%, 30%, 20%, and 10% at a monthly interval, right from the onset of the rainy season. Nevertheless, it has been shown that the addition of organic matters or amendments can significantly